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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/043,389	10/26/2001	Jan Martijn Krans	PHNL000578	4613

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EXAMINER	
JOHNSTON, PHILLIP A	

ART UNIT	PAPER NUMBER
2881	

DATE MAILED: 12/24/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	10/043,389	KRANS ET AL.
	Examiner	Art Unit
	Phillip A Johnston	2881

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _18 November 2003_.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-18_ is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _1-18_ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority und r 35 U.S.C. §§ 119 and 120

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☒ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

Detailed Action

Examiners Response to Arguments

1. Applicants arguments are moot in view of new grounds for rejection.

Claims Rejection – 35 U.S.C. 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-5 as Amended, and newly added Claims 6-18 are rejected under 35 U.S.C. 103(a), as being unpatentable over U.S. Patent No. 5,894,124 to Iwabuchi et al, in view of Sato, U.S. Patent No. 5,149,968, in further view of Talbot, U.S. Patent No. 6,252,412, and in still further view of Lo U.S. Patent No. 6,504,393.

Amended Claims 1-5, are rejected under 35 U.S.C. 103(a), as being unpatentable over U.S. Patent No. 5,894,124 to Iwabuchi et al, in view of Sato, U.S. Patent No. 5,149,968 for the reasons given in the previous office action.

Regarding the limitation in amended Claim 1 of “power supply means electrically connected between the holder and the electrostatic final electrode”; Iwabuchi (124) discloses in FIG. 1 a scanning electron microscope where a voltage V1 is applied between a cathode 1 of an electron gun and an extraction electrode 3, and a primary electron beam 2 is discharged from the cathode 1. The primary electron beam 2 is accelerated by a voltage Vacc applied between the cathode 1 and an accelerating electrode 4, and is then emitted to be converged to a sample 8 through a convergent lens 5 controlled by a lens controller 14 and an objective lens 6. Deflectors 7a, 7b deflect the primary electron beam 2 two-dimensionally so that the primary electron 2 scans the sample 8 two-dimensionally. A scanning signal supplied to the deflectors 7a, 7b is controlled by a deflection control circuit 12 on the basis of an observation magnification. An information signal electron 15 generated from the sample 8 by emission of the primary electron beam is accelerated by a voltage Vse applied to a lifting electrode 16, and is detected by an information signal electron detector 9b by way of the objective lens 6. An enlarged image of the sample is thus displayed on an image display 13.

A deflecting electrode device 17 is composed of two electrodes 19, 20 symmetrically disposed with respect the optical axis of the electron beam, as shown in

FIG. 2. Different voltages, which are respectively applied to the electrodes 19, 20, are controlled by a control unit 18 in accordance with the tilting of a sample stage 10 mounting the sample 8. The suitable selection of these voltages enables generation of an electric field component being large sufficient to compensate for an irregular electric field component generated in the direction perpendicular to the axis of the electron beam due to the tilting of the sample. This is effective to correct the nonaxisymmetric property, due to the tilting of the sample, of the electric field applied to the electron beam, and hence to suppress generation of astigmatism as a cause of lowering of resolution. See Figure 1, Column 3, line 56-67; and Column 4, line 1-35.

Iwabuchi (124) also discloses that a voltage applied to the deflecting electrode device 17 can be manually changed; however, the voltage is desirable to be automatically changed in practice. In this case, experiments have been made for obtaining a relationship for correcting an irregular electric field, that is, an nonaxisymmetric property of an electric field applied to an electron beam. In other words, a relationship of a voltage applied between the electrodes 19, 20 to a tilting angle of a sample has been previously obtained by experiments. Thus, the control unit 18 automatically changes, on the basis of the experimental results, a voltage applied between the electrodes 19, 20 in accordance with a variable tilting angle of the sample. In this embodiment, the control unit 18 serves as a source to apply a voltage to the deflecting electrode device 17; however, a power source unit may be provided separately from the control unit 18. See Column 4, line 55-67; and Column 5, line 1-3.

It is inherent in Figure 1, as described above, that control unit 18 is used as the power supply for both the final electrode 17, and the sample stage 10, which implies that they are electrically connected, as recited in amended Claim 1.

Iwabuchi (124) in view of Sato (968) as applied above to amended Claims 1-5, does not disclose the use of voltage contrast, as recited in new Claims 8 and 9. However, Talbot (412) discloses electron-optical column 600 that includes a large Field Of View (FOV) objective lens 616, such as a Variable Axis Immersion lens (VAIL). Objective lens 616 can be a VAIL lens similar to that used in the Schlumberger ATE IDS 5000 and IDS 10000 e-beam probing systems. For example, the lens is a magnetic-immersion type where the specimen is held approximately at the point of maximum axial magnetic field. The field of such a lens acts as a "magnetic bottle" and allows for collimation and efficient collection of secondary electrons without the need to apply a strong electrostatic collection field. A strong electrostatic collection field is undesirable as it may cause unstable surface charging and can preclude independent optimization of the wafer bias, extraction potential and energy filter to enhance voltage contrast. The lens can be equipped with both pre-deflection and deflection coils to achieve a large FOV (such as 0.25 mm to 1.5 mm across) with high resolution (such as 30-100 nm). In one embodiment, a FOV of 0.25-1.5 mm across has been demonstrated with resolution of <50 nm. An embodiment of a VAIL lens consistent with the present invention is described below with reference to FIG. 8.

Also in FIG. 6A, provision is made to apply independent bias voltages to extraction electrode 612 from bias source 614 and to wafer chuck 608 from bias source 610. Bias voltage applied to wafer chuck 608 is effectively applied also to the substrate of wafer 622. These bias voltages can be independently set, under computer control if desired, to optimize voltage contrast depending on the type of wafer being imaged and the type of defect to be detected. The system can be operated to produce either a positive or a negative specimen-surface voltage. The wafer bias can also be used to independently vary the beam-landing energy at the specimen's surface; this is desirable as some specimens with thin layers such as salicide require low landing energy without compromising resolution, to prevent charge leakage to other layers from beam punch-through.

In the embodiment of FIG. 6A, the bore of the lens is equipped with a planar filter electrode 628, also called an energy-filter mesh, having a bias voltage source 630. Electrode 628 serves as a retarding-field electron-energy spectrometer, as in the Schlumberger IDS 5000 & IDS 10000 systems. The energy filter can be used to optimize voltage contrast for certain wafer types by collecting secondary electrons with a specified energy range, for example in the range from zero to ~15 eV. See Column 9, line 61-67; and Column 10, line 1-10.

It is implied herein that efficient collection of secondary electrons in accordance with Talbot (412) is equivalent to "the collection efficiency being 25-75% of the maximum obtainable", as recited in new Claims 7 and 8.

Therefore it would have been obvious to one of ordinary skill in the art that the scanning electron microscope of Iwabuchi (124) in view of Sato (968) can be modified to use the voltage contrast method in accordance with Talbot (412) to improve the detection of defects .

Regarding new Claims 12, 13, and 16, Iwabuchi (124) in view of Sato (968) in further view of Talbot (412) discloses nearly all the limitations of Claims 12, 13, and 16, but does not disclose the use of specimen regions having conductive strips on an integrate circuit. Lo (393); however, discloses that electron beam systems based on the voltage contrast principle have been developed for detecting open and short faults of conductors on multichip-module (NCM) substrates and flat panel displays. The basic operational principle is that the circuit conductor voltage can be determined from the intensity of the detected secondary electrons ("voltage contrast"); given this information it is possible to find open and short faults in the circuit patterns. In the examples given above, an electron beam is used to charge up a net (a chain of connected nodes) and the voltages on the nodes in this net or the nodes in the neighboring nets are subsequently examined. Since all nodes in the charged net are expected to charge up, any non-charged nodes
indicate open faults. On the other hand, any charged up nodes in the near-by nets signal short faults. In case of testing flat panel displays, an electron beam is used to charge each pixel cell and the equilibrium potential is determined. Two different types of defects can be detected: open- or short-pixel. An open-pixel has a higher final

charging potential when compared to a normal pixel while a short-pixel has a lower final charging potential.

Electron-beam voltage contrast has also been demonstrated for detecting open and short faults on unfinished semiconductor wafers, which are invisible to optical inspection systems. To prevent beam-induced damage of the wafer, a low voltage beam has to be used. A high voltage beam will cause beam penetration damage and can charge the surface to a harmful high voltage; a low voltage beam, on the other hand, charges the surface positively, and the charging mechanism is self regulated to less than a few volts. A voltage contrast image shows distinction between floating metal lines (charged up positively) and grounded metal line to the substrate (uncharged). Because this system can only differentiate the two states, the detectable defects can be generalized into two types: should-be floating metal lines that are grounded because of a bad short to the substrate, or should-be grounded metal lines that are floating because of a broken connection. This technique is most suitable for detecting defects in circuit patterns, which contain a mixture of floating and grounding conductors; which is often the case at the late stage of the fabrication.

Unfortunately, when inspecting at a late stage, it can be very difficult to isolate defects when the metal lines have been connected into complex networks. To by-pass this limitation, some inspections are conducted in laboratories on wafers in the early stage of the fabrication (metal 1 and 2) by externally grounding certain metal lines. This approach, however, can only be done off-line and requires a skillful operator to achieve good results. See Column 1, line 24-64.

Therefore it would have been obvious to one of ordinary skill in the art that the voltage contrast method of Iwabuchi (124) in view of Sato (968) in further view of Talbot (412) can be modified to use grounding of metal lines in accordance with Lo (393), to detect defects in integrated circuit patterns .

Conclusion

4. The Amendment filed on 11-18-2003 has been considered but the arguments are moot in view of new grounds for rejection.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Phillip A Johnston whose telephone number is 305 7022. The examiner can normally be reached on 7:30 to 4:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John R Lee can be reached on 703 308 4116. The fax phone numbers for the organization where this application or proceeding is assigned are 703 872 9318 for regular communications and 703 872 9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703 308 0956.

PJ

[redacted]
12/12/03